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Seasonal Cointegration Approach to Government Revenue and Government Expenditure Nexus: Evidence from Turkey

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Abstract: *The aim of this study is investigating the causal relationship between the government expenditure and revenue for Turkish economy over the period of first quarter of 1987 to the fourth quarter of 2008 using seasonal unit roots test as developed by Hylleberg et al. (1990) and seasonal cointegration procedure as developed by Lee (1992). The empirical results indicate the unidirectional causality running from the government expenditure to revenue that support spend and tax hypothesis and provide the view that the government should cut the spending to control the size of budget deficits and later raise taxes to increase government revenue.*

Keywords: *spend and tax, seasonal cointegration, seasonal unit root*

JEL Classification: *C22, E62*

1. INTRODUCTION

The determination of the causal relationship between government revenue and expenditure is an essential topic in terms of fiscal policies especially for developing countries. The governments in developing countries often come up against large budget deficits. The large and persistent budget deficits and instruments of financing these deficits make difficulties in making budgetary decisions for governments. The governments have two fiscal policy choices to eliminate the budget deficits: to raise taxes or to reduce the expenditures. From this point of view, the causal relationship between government revenue and expenditure helps in making budgetary decisions and to fix fiscal disequilibrium.

In the theoretical framework, there are four alternative hypotheses to explain the causal relationship between government revenue and expenditure. The first hypothesis which put forward by Friedman (1978) is known as "tax and spend hypothesis". Tax and spend hypothesis presents that the governments raise the taxes first and then the resources obtained by revenues are used for government spending

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at the following periods. This hypothesis presents the direction of causality running from revenue to expenditure.

The second hypothesis is put forward by Peacock and Wiseman (1967, 1979) and known as "spend and tax hypothesis" which the governments decide to spend first and determine additional resources to increase revenues at the following periods. Spend and tax hypothesis presents that government expenditure causes the revenues. The third hypothesis is put forward by Musgrave (1966) and Meltzer and Richard (1981) and known as "fiscal synchronization hypothesis". The fiscal synchronization hypothesis advocates that the governments take decisions on spending and taxation simultaneously by considering the impacts of these decisions on budget balance. This hypothesis argues the bidirectional causality between government revenue and expenditure.

The last hypothesis, which is put forward by Wildavsky (1988) and Baghestani and McNown (1994) and known as "institutional separation hypothesis", argues that the governments take decisions on spending independently from taxation and vice versa. The institutional separation hypothesis presents that government revenue does not cause expenditure and the government expenditure does not cause the revenue as well.

The causality between the government revenue and expenditure has been investigated by numbers of studies which have mixing and conflicting findings for both developed and developing countries using different econometric techniques.

von Furstenberg *et al.* (1985, 1986), Anderson *et al.* (1986), Ross and Payne (1998) and Islam (2001) examined the causality between the government revenue and expenditure and found that spend and tax hypothesis is the valid hypothesis for the United States. On the other hand, Blackley (1986), Ram (1988), Bohn (1991), Mounts and Sowell (1997), Koren and Stiassny (1998), Garcia and Henin (1999) and Chang *et al.* (2002) found empirical results that government revenue causes expenditure in the United States. Ahiakpor and Amirkhalkhali (1989), Payne (1997) and Garcia and Henin (1999) put forward the same causal relationship for Canada.

Manage and Marlow (1986), Miller and Russek (1989), Hassan and Sukar (1996) found evidence of bidirectional causality between government revenue and expenditure that support the fiscal synchronization hypothesis for the United States. Owoye (1995) investigated the causality between government revenue and expenditure for G-7 countries and found the direction of causality running form revenue to expenditure for Italy and Japan and found the empirical evidence of bidirectional causal relationship between revenue and expenditure for the United States, United Kingdom, France, Germany and Canada.

Joulfaian and Mookerjee (1991) found the empirical evidence of tax and spend hypothesis for Canada and Italy, spend and tax hypothesis for Austria, Finland, France, Greece, Japan, United Kingdom and United States, fiscal synchronization

hypothesis for Ireland and institutional separation hypothesis for Australia, Belgium, Denmark, Iceland, Luxembourg, Netherlands, Norway Portugal, Spain, Sweden and Switzerland.

Hondroyiannis and Papapetrou (1996), Vamvoukas (1997) found the causal relationship running from expenditure to revenue for Greece and Katrakilidis (1997) found the evidence of causality between revenue and expenditure mutually. Darrat (1998) found empirical evidence of tax and spend hypothesis for Turkey. Narayan and Narayan (2006) found the empirical evidence from developing countries that support the spend and tax hypothesis for Haiti, tax and spend hypothesis for Mauritius, El Salvador, Chile and Venezuela and fiscal synchronization hypothesis for Peru, South Africa, Guatemala, Uruguay and Ecuador. AbuAl-Foul and Baghestani (2004) found the evidence in support of tax and spend hypothesis for Egypt and fiscal synchronization hypothesis for Jordan. Sobhee (2004) found empirical evidence of the direction of causality running from government revenue and government expenditure for Mauritius. Konukcu-Önal and Tosun (2008) investigated the causal linkage between government revenue and government expenditure for Russian Federation, Kyrgyz Republic, Belarus, Kazakhstan, and they found evidence of tax and spend hypothesis for Belarus and Russian Federation, evidence of fiscal synchronization hypothesis for Kyrgyz Republic and Kazakhstan.

The aim of this study is investigating the causality between government revenue and expenditure for Turkey in seasonal unit root and seasonal cointegration framework by taking account of seasonal behaviors of expenditure and revenue series. For this purpose we use the seasonal unit roots test developed by Hylleberg, Engle, Granger and Yoo (1990) (henceforth HEGY (1990)) and seasonal cointegration and error correction model developed by Lee (1992). Mithani and Khoon (1999), to the best of our knowledge, is the only study that investigates the causality between government revenue and expenditure using the framework of seasonal unit roots test and seasonal cointegration test for a developing country, Malaysia. But differently, Mithani and Khoon (1999) apply the seasonal cointegration analysis developed by Engle, Granger, Hylleberg and Lee (EGHL, 1993) in their study.

In this study, we provide additional empirical evidence on extant literature from the case of another developing country, Turkey. Turkish economy is one of the noteworthy and curios examples in examining the government expenditure and government revenue nexus because Turkish economy has experienced chronic budget deficits since 1971 and the budget deficits has increased sharply about the last four decades. On the other hand, the proportion of government expenditure in Gross National Product (GNP) has also occurred higher than the proportion of government revenue in GNP about the last four decades.

The organization of the rest of the paper is as follows: in section 2 we discussed the econometric methodology used in the study and section 3 contains the data description and empirical results. The 4th and last section includes conclusions.

2. ECONOMETRIC METHODOLOGY

The seasonal fluctuations in economic time series can be handled by three different cases in an empirical framework. Firstly, seasonality may have deterministic properties and in this instance seasonality is included in models using seasonal dummy variables. The second case is that seasonality may follow stationary stochastic process and the third case is that seasonality may follow non-stationary stochastic process depending on seasonal unit roots.

HEGY (1990) present a procedure for quarterly data that allows testing seasonal and non-seasonal unit roots together. The procedure of HEGY test is based on the following model and transformations for the quarterly data of series x_t:

$$y_{4t} = \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-1} + \pi_4 y_{3,t-2} + \sum_{i=1}^{n} \beta_i y_{4,t-i} + \varepsilon_t \tag{1}$$

$$y_{1t} = (1 + L + L^2 + L^3)x_t \tag{2}$$

$$y_{2t} = -(1 - L + L^2 - L^3)x_t \tag{3}$$

$$y_{3t} = -(1 - L^2)x_t \tag{4}$$

$$y_{4t} = (1 - L^4)x_t = \Delta_4 x_t \tag{5}$$

It can be included the deterministic components such as an intercept, seasonal dummy variables and a linear trend variable to model (1). The lagged values $y_{4,t-i}$ are also added to model (1) to eliminate autocorrelation problem in residual terms and ensure "white noise" errors. L denotes the lag operator that shown in the equations (2), (3), (4) and (5). The y_{1t} transformation is applied for removing the all seasonal unit roots at semi-annual (π) and annual ($\pi/2$, $3\pi/2$) frequencies and detecting the non-seasonal unit root at zero (0) frequency. The y_{2t} transformation is applied for removing the non-seasonal unit root at zero (0) frequency and seasonal unit roots at annual ($\pi/2, 3\pi/2$) frequencies and detecting the seasonal unit root at semi-annual (π) frequency. Lastly, the y_{3t} transformation is applied for removing the non-seasonal unit root at zero (0) frequency and the seasonal unit root at semi-annual (π) frequency and detecting the seasonal unit roots at annual ($\pi/2$, $3\pi/2$) frequencies.

The null hypothesis of $\pi_1 = 0$ is tested for that x_t contains a non-seasonal (long-run) unit root at zero (0) frequency and the null hypothesis of $\pi_2 = 0$ is tested for that x_t contains a seasonal unit root at semi-annual (π) frequency using standard t-type test. The joint F-type test is performed for testing the null hypothesis of $\pi_3 = \pi_4 = 0$ that x_t contains seasonal unit roots at annual ($\pi/2$, $3\pi/2$) frequency.

In the existence of seasonal unit roots, it is not appropriate to perform the standard cointegration tests. If the series are integrated of order one at any frequencies 0, π and/or $\pi/2$, the linear of combination of the series are stationary also at the frequencies 0, π and/or $\pi/2$. For instance, if the series are integrated of order

one at zero (0) frequency, the cointegrating relation(s) should be examined at zero (0) frequency. The same circumstance is valid for the frequencies π and $\pi/2$ frequencies, respectively.

Lee (1992), who suggests a procedure which is different from the procedures of HEGY (1990) and Engle, Granger, Hylleberg and Lee (EGHL) (1993), presents maximum likelihood estimation method for quarterly data to determine cointegrating relations at zero ($\omega = 0$), semi-annual ($\omega = 1/2$) and annual ($\omega = 1/4$) frequencies. The seasonal error correction model (SECM) based on VAR specification that proposed by Lee (1992) is as following form:

$$\Delta_4 X_t = \Pi_1 Y_{1,t-1} + \Pi_2 Y_{2,t-1} + \Pi_3 Y_{3,t-2} + \Pi_4 Y_{3,t-1} + \sum_{j=1}^{p} \Gamma_j \Delta_4 X_{t-j} + \varepsilon_t \quad (6)$$

The representation (6) is similar to the representation of HEGY seasonal unit roots test that shown at (1), while the representation (1) corresponds to univariate processes; the representation (6) denotes multivariate processes. $\Pi_i = \alpha_i \beta_i'$ $(i = 1,2,3,4)$ are the long-run coefficient matrices and estimated using canonical correlations. If the ranks of Π_1 and Π_2 are different from zero, it is implied that there is cointegrating relation at zero ($\omega = 0$) and seasonal cointegrating relation at semi-annual ($\omega = 1/2$) frequencies, respectively. If the rank of Π_3 is different from zero, it is implied that there is seasonal cointegrating relation at annual ($\omega = 1/4$) frequency. The test of seasonal frequency at $\omega = 1/4$, as noted by Lee (1992), is tested on the matrix Π_3 only on assuming $\Pi_4 = 0$ when cointegration is contemporaneous (Shen and Huang, 1999).

3. DATA AND EMPIRICAL RESULTS

In this section, we investigate the causality between the government revenue and expenditure in Turkey, over the period the first quarter of 1987 to the fourth quarter of 2008. The data is obtained from the Central Bank of Republic of Turkey Electronic Delivery Data System. The real values of government revenue and expenditure variables are formed by using GDP deflator (2005 = 100) and both of the variables are transformed in natural logarithmic form.

Firstly, we investigate the order of integration of the variables that government revenue (*RE*) and expenditure (*EX*) at 0, π and $\pi/2$ ($3\pi/2$) frequencies by employing the HEGY seasonal unit roots test. The results of HEGY seasonal unit roots test are shown at Table 1.

The results obtained from HEGY seasonal unit roots test indicate that the null hypothesis of non-seasonal unit root ($\pi_1 = 0$) and the null hypothesis of seasonal unit root ($\pi_2 = 0$) can not be rejected for both of *RE* and *EX* series at zero (0) and semi-annual frequencies, respectively. Conversely, the null hypothesis of seasonal unit root ($\pi_3 = \pi_4 = 0$) is rejected at annual frequency for *EX* series but not for *RE* series.

Table 1
The Results of HEGY Seasonal Unit Roots Test

Variables	*Deterministic Components*	*Lag Length*	$t(\pi_1)$	$t(\pi_2)$	$F(\pi_3 \cap \pi_4)$
EX	-	4	2.414*	-1.641**	4.701*
	I	4	-1.411**	-1.599**	4.318*
	I.SD	0	-0.986**	-4.178	18.877
	I,TR	4	-2.441**	-1.601**	4.395*
	I,SD,TR	0	-2.468**	-4.292	20.081
RE	-	0	3.464	-2.518*	10.471
	I	0	-0.687**	-2.500*	10.275
	I.SD	5	-1.055**	-3.134*	12.780
	I,TR	3	-3.460**	-2.053*	5.379
	I,SD,TR	3	-3.348**	-2.617**	9.869

Notes: * and ** denote the existence of non-seasonal or seasonal unit roots at the 1% and 5% significant levels, respectively. The lagged values of $y_{4,t}$ in the auxiliary regressions are determined through Akaike Information Criterion (AIC). I, SD and TR represent the deterministic components that are Intercept, Seasonal Dummy Variables and Linear Trend, respectively. The critical values are taken from HEGY (1990).

Accordingly, the order of integration of *RE* and *EX* series would be determined to be *I*(1) at zero and semi-annual frequencies and additionally only *EX* series would be determined to be *I*(1) at annual frequency. Therefore, seasonality in government revenue and expenditure series is consistent with non stationary stochastic processes.

Once determining the order of integration of *RE* and *EX* series is *I*(1) at both of the zero and semi-annual frequencies, we apply Lee's (1992) seasonal cointegration test that is based on maximum likelihood estimation method. We examine the cointegrating relations applying trace (*LR*) test presented by Lee (1992) for zero ($\omega = 0$) and semi-annual ($\omega = 1/2$) frequencies, respectively. Firstly, we specify a convenient VAR model for the raw *RE* and *EX* series and construct the VAR model including a linear trend variable and seasonal dummy variables following Cubadda (1999). We select the order of VAR model as 8 using Akaike information criterion (AIC) and the diagnostic tests indicate that VAR(8) model has no misspecification problem. The results of trace (*LR*) test at zero ($\omega = 0$) and semi-annual ($\omega = 1/2$) frequencies and the results of estimation of normalized coefficients at frequencies of interest are reported at Table 2.

According to the trace (LR) test results of Lee's (1992) seasonal cointegration procedure, the null hypothesis of $r = 0$ can not be rejected for zero frequency at 5% significant level. On the other hand, the null hypothesis of $r = 0$ is rejected but the null hypothesis of $r = 1$ can not be rejected for the semi-annual frequency at 5% significant level. Thus, we determine one cointegrating vector which belongs to semi-annual

Table 2
The Trace (LR) Test Results of Seasonal Cointegration and Estimates of Normalized Coefficients

Frequency	$H_0 : r = 0$	$H_0 : r = 1$
$\omega = 0$	10.17411	-
$\omega = 1/2$	29.03479*	4.25784
Normalized Coefficients	RE	EX
$\omega = 1/2$	1	1.03206

Notes: * denotes the rejection of null hypothesis of no cointegration at the 5% significant level. The critical values are taken from Lee and Siklos (1995).

frequency is (1, 1.03206). The cointegrating vector that denotes the equilibrium error process can be shown as following for semi-annual ($\omega = 1/2$) frequency:

$$\mathrm{SEC}_{1/2,t} = -(1 - L + L^2 - L^3)\ (RE_t - 1.03206\ EX_t) \tag{7}$$

These results support that there is seasonal cointegrating relationship between *RE* and *EX* at semi-annual frequency. The presence of seasonal cointegrating relationship at semi-annual frequency represent the causal relationship which runs at least one direction between *RE* and *EX*. After determining the seasonal cointegrating relationship, we examine the causality between government expenditure and revenue constructing SECMs as following:

$$\Delta_4 EX_t = \alpha_1 + \sum_{i=1}^{m} \beta_{1i} \Delta_4 EX_{t-i} + \sum_{i=1}^{m} \phi_{1i} \Delta_4 RE_{t-i} + \delta_1 SEC_{1/2,t-1} + \varepsilon_{1t} \tag{8}$$

$$\Delta_4 \mathrm{RE}_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i} \Delta_4 \mathrm{RE}_{t-i} + \sum_{i=1}^{n} \phi_{2i} \Delta_4 EX_{t-i} + \delta_2 SEC_{1/2,t-1} + \varepsilon_{2t} \tag{9}$$

The direction of causality between government revenue and expenditure can be determined by estimating OLS regression of equations in (8) and (9). For investigating the causality which runs from the government revenue to expenditure, one can test the null hypothesis of $\phi_{1i} = \delta_1 = 0$ for equation (8). The rejection of the null hypothesis of $\phi_{1i} = \delta_1 = 0$ indicates the evidence for the causal relationship which runs from the government revenue to expenditure and supports tax and spend hypothesis. On the other hand, for investigating the causality which runs from the government expenditure to revenue, one can test the null hypothesis of $\phi_{2i} = \delta_2 = 0$ for equation (9). The rejection of the null hypothesis of $\phi_{2i} = \delta_2 = 0$ indicates that the government expenditure causes revenue and supports spend and tax hypothesis. If both of the null hypotheses $\phi_{1i} = \delta_1 = 0$ and $\phi_{2i} = \delta_2 = 0$ are rejected, then the bi-directional causality between the government revenue and expenditure and consequently the fiscal synchronization hypothesis is supported.

We determine the lag lengths of n and m as 4 through Akaike information criterion (AIC) and estimate the equations (8) and (9) by OLS method. The results of SECMs are shown at Table 3.

Table 3
The Estimation Results of Seasonal Error Correction Models

	$\Delta_4 EX_t$		$\Delta_4 RE_t$	
Regressors	*Coefficients*	*t-statistics*	*Coefficients*	*t-statistics*
Constant	0.06297	2.71760*	0.05097	3.36078*
$\Delta_4 EX_{t-1}$	0.08457	0.68615	0.10131	1.25602
$\Delta_4 EX_{t-2}$	0.18023	1.50006	-0.01471	-0.18713
$\Delta_4 EX_{t-3}$	0.13063	1.05331	0.21893	2.69729*
$\Delta_4 EX_{t-4}$	-0.32010	-2.47172*	-0.00342	-0.04030
$\Delta_4 RE_{t-1}$	0.14898	0.79078	0.07300	0.59204
$\Delta_4 RE_{t-2}$	-0.13512	-0.72789	0.23663	1.94776**
$\Delta_4 RE_{t-3}$	0.23769	1.25200	-0.04552	-0.36631
$\Delta_4 RE_{t-4}$	-0.38286	-2.00431*	-0.34469	-2.75720*
$SEC_{1/2,t-1}$	0.11658	1.21526	-0.12130	-1.93221**
Serial Correlation (χ^2_{LM})	5.24609***		0.25310***	
Heteroskedasticity (χ^2_{WHITE})	10.36065***		11.71725***	
Normality $(\chi^2_{JARQUE-BERA})$	1.05498***		0.30555***	
Stability $(F_{RAMSEY-RESET})$	2.92608***		0.09775***	

Notes: * and ** denote statistically significance at 5% and 10% levels, respectively. *** denotes that the null hypotheses of tests of interest can not be rejected at 5% significant level.

The estimation results of seasonal error correction model that belongs to the government expenditure report that $SEC_{1/2,t-1}$ is not statistically significant. On the other hand, $SEC_{1/2,t-1}$ error correction term is statistically significant at the 10% level in the government revenue equation. The budgetary coefficient that corresponds to the government expenditure ($SEC_{1/2,t-1}$) is 0.11 and the budgetary coefficient that corresponds to government revenue ($SEC_{1/2,t-1}$) is -0.12 in the government revenue equation. But $SEC_{1/2,t-1}$ has a negative sign only in government revenue equation that implies the government revenue could adjust the budget disequilibrium with a correct sign. Moreover, the government expenditure and revenue equations pass the all diagnostics tests as shown at Table 3. The findings on the significance of $SEC_{1/2,t-1}$ in government revenue equation consistent with evidence for spend and tax hypothesis.

We also determine the direction of causality testing the null hypotheses of $\phi_{1i} = \delta_1 = 0$ and $\phi_{2i} = \delta_2 = 0$ for the government expenditure and the government revenue equations, respectively. The results of causality test are reported at table 4.

Table 4
The Results of Causality Test

	$\phi_{1i} = \delta_1 = 0$	$\phi_{2i} = \delta_2 = 0$
$EX \not\Rightarrow RE$	10.10810*	-
$RE \not\Rightarrow EX$	-	6.94149

Note: * denotes rejection of null hypothesis of non-causality at 10% significant level.

The calculated χ^2–*statistic* for testing the causality running from the government expenditure to government revenue is 10.10810 and significant at 10% level, but the calculated χ^2–*statistic* for testing causality running from the government revenue to government expenditure is 6.94149 and statistically insignificant. The results of χ^2 *tests* support the unidirectional causality running from the government expenditure to government revenue. In consideration of the results of χ^2 *tests* for the government expenditure and government revenue equations and the significance of $SEC_{1/2,t-1}$ in government revenue equation, spend and tax hypothesis is supported for Turkey.

4. CONCLUSIONS

In this study, we investigate the causal relationship between the government expenditure and revenue for Turkey using seasonal unit roots test as developed by Hylleberg *et al.* (1990) and seasonal cointegration procedure based on maximum likelihood estimation method as developed by Lee (1992). We determine that the government expenditure and revenue series follow non-stationary stochastic seasonal behaviors and also the empirical findings indicate the unidirectional causality running from the government expenditure to revenue that support spend and tax hypothesis.

According to the empirical evidence for the unidirectional causality running from the government expenditure to government revenue, the development of budget deficits of Turkish economy causes on the spending decisions over the first quarter of 1987 to the fourth quarter of 2008. The empirical findings on spend and tax hypothesis also provide the view that the government should cut the spending to control the size of budget deficits and later raise taxes to increase government revenue. But this finding could be an irrational fiscal policy tool in terms of socio economic reasons for Turkish economy. Although Turkey is the country which the charge of taxation is the least among the all OECD countries; Turkey has the highest the charge of taxation on salaries of employees among the all OECD countries. This circumstance is an indicator of that the charge of taxation is heavy for the employees and unfair in Turkish economy.

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